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The Determinants of Banking Crises

Evidence from Industrial and Developing Countries

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Enrica Detragiache

Vulnerability to crises in the banking sector appears to be associated with these factors: a weak macroeconomic environment characterized by slow GDP growth and high inflation, vulnerability to sudden capital outflows, low liquidity in the banking sector, a high share of credit to the private sector, past credit growth, the existence of explicit deposit insurance, and weak institutions.

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Summary findings

In the 1980s and 1990s several countries experienced banking crises. Demirgüç-Kunt and Detragiache try to identify features of the economic environment that tend to breed problems in the banking sector.

They do so by econometrically estimating the probability of a systemic crisis, applying a multivariate logit model to data from a large panel of countries, both industrial and developing, for the period 1980–94. Included in the panel as controls are countries that never experienced banking problems.

The authors find that crises tend to occur in a weak macroeconomic environment characterized by slow GDP growth and high inflation. When these effects are controlled for, neither the rate of currency depreciation nor the fiscal deficit are significant.

Also associated with a higher probability of crisis are vulnerability to sudden capital outflows, low liquidity in the banking sector, a high share of credit to the private sector, and past credit growth.

Another factor significantly (and robustly) associated with increased vulnerability in the banking sector is the presence of explicit deposit insurance, suggesting that moral hazard has played a major role.

Finally, countries with weak institutions (as measured by a "law and order" index) are more likely to experience crises.

This paper — a product of the Development Research Group, World Bank, and the Research Department, International Monetary Fund — is part of a larger effort to understand the causes of banking crises. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Paulina Sintim-Aboagye, room N9-030, telephone 202-473-8526, fax 202-522-1155, Internet address psintimaboagye@worldbank.org. September 1997. (46 pages)

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I. INTRODUCTION

In the 1980s and early 1990s several developed economies, developing countries, and economies in transition experienced severe banking crises. Such proliferation of large scale banking sector problems has raised widespread concern, as banking crises disrupt the flow of credit to households and enterprises, reducing investment and consumption and possibly forcing viable firms into bankruptcy. Banking crises may also jeopardize the functioning of the payments system and, by undermining confidence in domestic financial institutions, they may cause a decline in domestic savings and/or a large scale capital outflow. Finally, a systemic crisis may force sound banks to close their doors.

In most countries, policy makers have responded to banking crises with various interventions, ranging from loose monetary policy to the bail out of insolvent financial institutions with public funds. Even when they are carefully designed, however, rescue operations have several drawbacks: they are often very costly for the budget; they may allow inefficient banks to remain in business; they are likely to create the expectation of future bail-outs thereby reducing incentives for adequate risk management by banks. Rescue operations may also weaken managerial incentives when, as it is often the case, they force healthy banks to bear the losses of ailing institutions. Finally, loose monetary policy to prevent banking sector losses can be inflationary and, in countries with an exchange rate commitment, it may trigger a speculative attack against the currency.

Preventing the occurrence of systemic banking problems is undoubtedly a major concern of policy makers, and understanding the mechanisms that are behind the surge in banking crises in the last fifteen years is a first step in this direction. Recently, a number of studies have analyzed various episodes of banking sector distress in an effort to draw useful policy lessons (see Section 3 below).[1] Most of this work consists of case studies, and econometric analyses are few. González-Hermosillo *et al.* (1997) use an econometric model to predict bank failures using Mexican data for 1991-95. In a paper focused primarily on the connection between banking crises and balance of payments crises, Kaminsky and Reinhart (1996) examine the behavior of a number of macroeconomic variables in the months before and after a crisis in a sample of 20 countries; using a methodology developed for predicting the turning points of business cycles, they attempt to identify variables that act as "early warning signals" for crises.[2] The best signals appear to be a loss of foreign exchange reserves, high real interest rates, low output growth, and a decline in stock prices.

The goal of this study is to further investigate the features of the economic environment that tend to breed banking sector fragility and, ultimately, lead to systemic banking crises. Rather than focusing on the behavior of high frequency time series around the time of the crisis, we study the determinants of the probability of a banking crisis in a multivariate logit specification with annual data using a large panel including all market economies for which data

[1]Some of these studies also discuss at length the strategies adopted to rescue the banking system, a topic that we do not address in this paper.

[2]While this approach provides numerous interesting insights, it is open to the criticism that the criteria used to establish which variables are useful signals are somewhat arbitrary.

were available in the period 1980-94[3]. Many countries in our sample do not experience systemic banking crises in the period under consideration, and therefore serve as controls. The explanatory variables capture many of the factors suggested by the theory and highlighted by case studies, including not only macroeconomic variables but also structural characteristics of the economy in general and of the financial sector in particular. This approach allows us to identify a number of interesting correlations; however, because we estimate a reduced form relationship without deriving it from a specific structural model of the economy, such correlations should be interpreted with caution as they may not necessarily reflect direct causal links.

The first issue that we explore is which (if any) elements of the macroeconomic environment are associated with the emergence of banking crises. We find that low GDP growth, excessively high real interest rates, and high inflation significantly increase the likelihood of systemic problems in our sample; thus, crises do not appear to be solely driven by self-fulfilling expectations as in Diamond and Dybvig (1983). This confirms the evidence presented by Gorton (1988) on the determinants of bank runs in the U.S. during the nineteenth century.[4] Adverse terms of trade shocks also tend to increase the likelihood of banking sector problems, but here the evidence is weaker. The size of the fiscal deficit and the rate of

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[3] A methodology similar to our has been used to study currency crises (see, for instance, Eichengreen *et al.*, 1996) and factors that lead to Fund financial arrangements (Knight and Santaella, 1994). Economies in transition are excluded from our study even though they have experienced some of the worst banking crises. We believe that some of the banking problems in these economies are due to the process of transforming a centrally planned economy into a market economy, and are therefore of a distinctive nature.

[4] It should be pointed out, however, that without a theory of how beliefs are formed in rational expectations models with multiple equilibria, this evidence cannot rule out that crises have a self-fulfilling component, since pessimistic, self-fulfilling beliefs may tend to emerge when macroeconomic fundamentals are weak.

depreciation of the exchange rate, on the other hand, do not seem to have an independent effect in our sample.

A weak macroeconomic environment, however, is not the sole factor behind systemic banking sector problems. Structural characteristics of the banking sector and of the economic environment in general also play a role. Our tests show that -- as hypothesized by Calvo *et al.* (1994) -- vulnerability of the system to sudden capital outflows increases the probability of a banking crisis. This result, however, is not robust to the specification of the regression. We also find some evidence that problems are more likely where a larger share of credit goes to the private sector, possibly indicating a connection between the emergence from a state of financial repression and banking sector fragility.

Another interesting result, which is quite robust to the specification of the regression, is that the presence of an explicit deposit insurance scheme makes bank unsoundness more likely. While explicit deposit insurance should reduce bank fragility by eliminating the possibility of self-fulfilling panics, it is well-known that it creates incentives for excessive risk-taking by bank managers (moral hazard). Our evidence suggests that, in the period under consideration, moral hazard played a significant role in bringing about systemic banking problems, perhaps because countries with deposit insurance schemes were not generally successful at implementing appropriate prudential regulation and supervision, or because the deposit insurance schemes were not properly designed. Also, a variable capturing the effectiveness of the legal system is found to be significantly negatively correlated with the emergence of banking sector problems, possibly suggesting that banking crises are more likely where outright fraud or more minor

violations of contractual covenants, corporate charters, and prudential regulation tend to go unpunished.

Using estimates of the cost of banking crises from Caprio and Klingebiel (1996), we test whether the set of explanatory variables used in the logit model can also account for the severity of each crisis. We find that most of the variables that tend to make crises more likely also tend to make them more costly. Since the size of the sample is small due to data limitations, these results should be interpreted with caution.

The paper is structured as follows: the next section reviews the theory of the banking firm to identify potential sources of systemic banking crises. Section 3 explains the design of the econometric tests, while Section 4 contains the main results. In Section 5, we present further results on the determinants of the severity of banking crises. Section 6 briefly details sensitivity tests, and Section 7 concludes.

II. THE THEORY

The banking literature suggests a variety of mechanisms that can bring about banking sector problems; in this section, these mechanisms are reviewed, while in the rest of the paper we will use our data set to identify which of these mechanisms have played a major role in the crises of the 1980s and early 1990s.

Banks are financial intermediaries whose liabilities are mainly short-term deposits and whose assets are usually short and long-term loans to businesses and consumers. When the value of their assets falls short of the value of their liabilities, banks are insolvent. The value of a bank's assets may drop because borrowers become unable or unwilling to service their debt

(credit risk). Credit risk can be reduced in various ways, such as screening loan applicants, diversifying the loan portfolio by lending to borrowers who are subject to different risk factors, or asking for collateral. Appropriate screening can ensure that projects that are unprofitable *ex ante* are not financed; but risky projects that are profitable in an *ex ante* sense may still fail *ex post*. Also, portfolio diversification is unlikely to eliminate default risk completely, especially for banks that operate in small countries or regions, or that specialize in lending to a particular sector. Finally, collateral is costly to establish and monitor, and its value is typically subject to fluctuations. Thus, default risk cannot be entirely eliminated without severely curtailing the role of banks as financial intermediaries[5]. If loan losses exceed a bank's compulsory and voluntary reserves as well as its equity cushion, then the bank is insolvent. When a significant portion of the banking system experiences loan losses in excess of its capital, a systemic crisis occurs.

Thus, the theory predicts that shocks that adversely affect the economic performance of bank borrowers and whose impact cannot be reduced through risk diversification should be positively correlated with systemic banking crises. Furthermore, for given shocks banking systems that are less capitalized should be more vulnerable. The empirical literature has highlighted a number of economic shocks associated with episodes of banking sector problems: cyclical output downturns, terms of trade deteriorations, declines in asset prices such as equity and real estate (Gorton, 1988, Caprio and Klingebiel, 1996, Lindgren *et al.*, 1996, Kaminsky and Reinhart, 1996).

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[5] The amount of risk that bank managers choose to take on, however, is likely to exceed what is socially optimal because of limited liability (Stiglitz, 1972). Hence the need for bank regulators to impose minimum capital requirements and other restrictions. When bank deposits are insured, incentives to take on excessive risk are even stronger (see below). On the theory of bank prudential regulation, see Dewatripont and Tirole (1994).

Even in the absence of an increase in non-performing loans, bank balance sheets can deteriorate if the rate of return on bank assets falls short of the rate that must be paid on liabilities. Perhaps the most common example of this type of problem is an increase in short-term interest rates that forces banks to increase the interest rate paid to depositors.[6] Because the asset side of bank balance sheets usually consists of loans of longer maturity at fixed interest rates, the rate of return on assets cannot be adjusted quickly enough, and banks must suffer reduced profits or bear losses. All banks within a country are likely to be exposed to some degree of interest rate risk because maturity transformation is one of the typical functions of the banking system; furthermore, high real interest rates are likely to hurt bank balance sheets even if they can be passed on to borrowers, as high lending rates result in a larger fraction of non-performing loans. Thus, a large increase in short-term interest rates is likely to be a major source of systemic banking sector problems. In turn, the increase in short-term interest rates may be due to various factors, such as an increase in the rate of inflation, a shift towards more restrictive monetary policy that raises real rates, an increase in international interest rates, the removal of interest rate controls due to financial liberalization (Galbis, 1993), or the need to defend the exchange rate against a speculative attack (Velasco, 1987, Kaminsky and Reinhart, 1996)[7].

Another case of rate of return mismatch occurs when banks borrow in foreign currency and lend in domestic currency. In this case, an unexpected depreciation of the domestic currency threatens bank profitability. Many countries have regulations limiting banks' open

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[6] According to Mishkin (1996), most banking panics in the U.S. were preceded by an increase in short term interest rates.

[7] On the determinants of high interest rates in developing and transition economies see Brock (1995).

foreign currency positions, but sometimes such regulations can be circumvented (Garber, 1996). Also, banks that raise funds abroad may choose to issue domestic loans denominated in foreign currency, thus eliminating the open position. In this case, foreign exchange risk is shifted onto the borrowers, and an unexpected devaluation would still affect bank profitability negatively through an increase in non-performing loans. Foreign currency loans were a source of banking problems in Chile in 1981 (Akerlof and Romer, 1993), in Mexico in 1995 (Mishkin, 1996), in the Nordic countries in the early 1990s (Drees and Pazarbaşıoğlu, 1995, Mishkin, 1996), and in Turkey in 1994.

When bank deposits are not insured, a deterioration in the quality of a bank's asset portfolio may trigger a run, as depositors rush to withdraw their funds before the bank declares bankruptcy. Because bank assets are typically illiquid, runs on deposits accelerate the onset of insolvency. In fact, as Diamond and Dybvig (1983) have shown, bank runs may be self-fulfilling, i.e. they may take place simply because depositors believe that other depositors are withdrawing their funds even in the absence of an initial deterioration of the bank's balance sheet. The possibility of self-fulfilling runs makes banks especially vulnerable financial institutions. A run on an individual bank should not threaten the banking system as a whole unless partially informed depositors take it as a signal that other banks are also at risk (contagion).[8] In these circumstances, bank runs turn into a banking panic.

[8] For an in-depth discussion of the theory of bank runs, see Bhattacharya and Thakor (1994).

Bank runs should not occur when deposits are insured against the risk of bank insolvency; deposit insurance may be explicit, i.e. banks may purchase full or partial insurance on behalf of depositors from a government agency or from a private insurer, or it may be implicit, if depositors (correctly) believe that the government will either prevent the bank from failing or that, in case of failure, it would step in and compensate depositors for their losses. If the premia do not fully reflect the riskiness of bank portfolios, then the presence of deposit insurance creates incentives for taking on excessive risk (moral hazard) (Kane, 1989). The effects of moral hazard are likely to be negligible when the banking system is tightly controlled by the government or by the Central Bank. On the other hand, when financial liberalization takes place -- as it has been in many countries in the last 15 years -- the opportunities for risk-taking increase substantially. Thus, if financial liberalization takes place in countries with deposit insurance, and it is not accompanied by a well-designed and effective system of prudential regulation and supervision, then excessive risk taking on the part of bank managers is possible, and banking crises due to moral hazard may occur. To summarize, the theory is ambiguous as to the sign of the correlation between deposit insurance and banking crises: on the one hand, when deposits are insured self-fulfilling crises should not occur; on the other hand, banking crises due to adverse macroeconomic shocks could be more likely because bank managers choose riskier loan portfolios.

In countries in which the banking sector is liberalized but bank supervision is weak and legal remedies against fraud are easy to circumvent, banking crises may also be caused by widespread "looting": bank managers not only may invest in projects that are too risky, but they may invest in projects that are sure failures but from which they can divert money for personal

use. Akerlof and Romer (1993) claim that looting behavior was at the core of the savings and loan crisis in the U.S. and of the Chilean banking crisis of the late 1970s. Thus, a weak legal system that allows fraud to go unpunished should increase the probability of a banking crisis.

A sudden withdrawal of bank deposits with effects similar to those of a bank run may also take place after a period of large inflows of foreign short-term capital, as indicated by the experience of a number of Latin American, Asian, and Eastern European countries in the early 1990s. Such inflows, often driven by the combined effect of capital account liberalization and high domestic interest rates due to inflation stabilization policies, result in an expansion of domestic credit (Khamis, 1996). When foreign interest rates rise, domestic interest rates fall, or when confidence in the economy wavers, foreign investors quickly withdraw their funds, and the domestic banking system may become illiquid (Calvo *et al.*, 1994). As discussed by Obstfeld and Rogoff (1995) among others, in countries with a fixed exchange rate banking problems may also be triggered by a speculative attack against the currency: if a devaluation is expected to occur soon, depositors (both domestic and foreign) rush to withdraw their bank deposits and convert them into foreign currency deposits abroad, thus leaving domestic banks illiquid.[9]

Banking sector problems may also follow successful stabilization in countries with a history of high inflation; as shown by English (1996), chronic high inflation tends to be associated with an overblown financial sector, as financial intermediaries profit from the float on

[9] This mechanism seems to have been at work in Argentina in 1995: following the Mexican devaluation in December 1994, confidence in the Argentinean peso plunged, and the banking system lost 16 percent of its deposits in the first quarter of 1995 (IMF, 1996).

payments. When inflation is drastically reduced, banks see one of their main sources of revenue disappear, and generalized banking problems may follow[10].

III. THE EMPIRICAL SPECIFICATION AND THE CHOICE OF EXPLANATORY VARIABLES

The sample

Because of data availability, our study is limited to the 1980-94 period. To determine which countries to include, we began with all the countries in the IFS; we then eliminated centrally planned economies and economies in transition because the interrelation between the banking system and the rest of the economy is likely to be of a distinctive nature in these countries. Other countries had to be eliminated because the main macroeconomic and financial data series were missing or mostly incomplete. A few countries, such as Bangladesh and Ghana, were left out because their banking system was in a state of chronic distress for the entire period under consideration. Finally, three countries (Argentina, Brazil, and Bolivia) were excluded because they are outliers with respect to two of the regressors that we use (inflation and the real interest rate).[11] This process of elimination left us with a number of countries ranging from a maximum of 65 to a minimum of 45 depending on the specification of the regression.[12] A list of the countries included in the sample can be found in the data appendix.

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[10] Recently, banking sector difficulties in Brazil and Russia have been explained in this way (Lindgren *et al.*, 1996).

[11] As a robustness check, we have also estimated the model including the three outliers. See Section 5 below.

[12] Due to lack of data, for some countries the observations included in the panel do not cover the entire 1981-94 period.

The econometric model

We estimate the probability of a banking crisis using a multivariate logit model. In each period the country is either experiencing a crisis, or it is not. Accordingly, our dependent variable, the crisis dummy, takes the value zero if there is no crisis, and takes the value one if there is a crisis. Since we cannot predict a crisis with certainty, we estimate the probability that a crisis will occur at a particular time in a particular country, and we hypothesize that this probability is a function of a vector of n explanatory variables X(i, t). The choice of explanatory variables is discussed below. Let P(i, t) denote a dummy variable that takes the value of one when a banking crisis occurs in country i and time t and a value of zero otherwise. β is a vector of n unknown coefficients and $F(\beta'X(i, t))$ is the cumulative probability distribution function evaluated at $\beta'X(i, t)$. Then, the log-likelihood function of the model is:

$$\text{Ln } L = \sum_{t=1..T} \sum_{i=1..n} \{P(i,t)\ln[F(\beta'X(i,t))] + (1-P(i,t)) \ln[1- F(\beta'X(i,t))]\}.$$

In modeling the probability distribution we use the logistic functional form.[13] When interpreting the regression results it is important to remember that the estimated coefficients do not indicate the increase in the probability of a crisis given a one-unit increase in the corresponding explanatory variables. Instead, in the above specification, the coefficients reflect the effect of a change in an explanatory variable on ln(P(i,t)/(1-P(i,t)). Therefore, the

[13] The logistic distribution is commonly used in studying banking difficulties. See for example, Cole and Gunther (1993) and Gonzalez-Hermosillo, *et al.* (1997).

increase in the probability depends upon the original probability and thus upon the initial values of all the independent variables and their coefficients. While the sign of the coefficient does indicate the direction of the change, the magnitude depends on the slope of the cumulative distribution function at $\beta'X(i,t)$. In other words, a change in the explanatory variable will have different effects on the probability of a crisis depending on the country's initial crisis probability. Under the logistic specification, if a country has an extremely high (or low) initial probability of crisis, a marginal change in the independent variables has little effect on its prospects, while the same marginal change has a greater effect if the country's probability of crisis is in an intermediate range.

After the onset of a banking crisis, the behavior of some of the explanatory variables is likely to be affected by the crisis itself. For instance, as described below one of the explanatory variables used in the regressions is the credit-to-GNP ratio; this ratio is likely to fall as a result of the banking crisis, and the reduction in credit may, in turn, affect another explanatory variable, GNP growth. Another regressor that may be affected by the banking crisis is the real interest rate, which is likely to fall due to the loosening of monetary policy that often accompanies banking sector rescue operations. Clearly, these feed-back effects would muddle the relationships that we try to identify, so in a first set of regressions we eliminate from the panel all observations following a banking crisis. The drawback of this approach is that we lose episodes of multiple crises, and that many observations for the late 1980s and early 1990s are excluded from the sample.

As an alternative approach, we identify the year in which each banking crisis ended based on information available in existing case studies (see below), and in a second set of

regressions we include in the panel all observations following the end date. This panel, of course, is considerably larger than the first, and it includes repeated banking crises. The drawback of this approach is that determining when the effects of a banking crisis come to an end is quite difficult, so the choice of which observations to include in the panel is somewhat arbitrary. Furthermore, in this set of regressions the probability that a crisis occurs in a country that had problems in the past is likely to differ from that of a country where no crisis ever occurred. To take this dependence into account, we include different additional regressors in the estimated equations such as the number of past crises, the duration of the last spell, and the time since the last crisis.

When using panel data, country fixed effects are often included in the empirical model to allow for the possibility that the dependent variable may change cross-country independently of the explanatory variables included in the regression. In logit estimation, including country fixed effects would require omitting from the panel all countries that did not experience a banking crisis during the period under consideration (Greene, 1997, p. 899). In our case, this would imply disregarding a large amount of available information, since -- as discussed below -- countries that did not experience crisis are more than half of the total. Furthermore, limiting the panel to countries with crises would produce a biased sample. Given these drawbacks, we believe that estimating the model using the full sample but without fixed effects is the preferable approach.[14] However, as a further robustness check

[14] An alternative strategy would be to estimate a probit model with random effects, since such a methodology would be compatible with using the entire data set. However, this model produces unbiased estimates only if the random effects are uncorrelated with the regressors, which is unlikely to be true in practice (Judge *et al.*, 1985, p. 527).

we have also estimated a fixed effects version of the model using only countries that experienced a crisis. The results are discussed in Section VI below.

The banking crisis variable

A key element in our study is the construction of the banking crisis dummy variable. To do it, we have identified and dated episodes of banking sector distress during the period 1980-94 using primarily four recent studies: Caprio and Klingebiel (1996), Kaminsky and Reinhart (1996), Lindgren *et al.* (1996), and Sheng (1995). Taken together, these studies form a comprehensive survey of banking sector fragility around the world; from our perspective, it was important to distinguish between fragility in general and crises in particular, and between localized crises and systemic crises. To this end, we established -- somewhat arbitrarily -- that for an episode of distress to be classified as a full-fledged crisis in our panel at least **one of the following** four conditions had to hold:

1. The ratio of non-performing assets to total assets in the banking system exceeded 10%;
2. The cost of the rescue operation was at least 2% of GDP;
3. Banking sector problems resulted in a large scale nationalization of banks;
4. Extensive bank runs took place or emergency measures such as deposit freezes, prolonged bank holidays, or generalized deposit guarantees were enacted by the government in response to the crisis.

Therefore, the premise behind our work is that when one or more of the above conditions obtains the problem is of a systemic nature and should be considered a banking crisis, while when none of the above occurs the problem is localized and/or relatively minor.

The criteria above were sufficient to classify as a crisis or not a crisis almost all of the fragility episodes identified by the literature. In a few cases, however, we had insufficient information and made a decision based on our best judgement. According to our classification, there were 31 episodes of systemic banking crises (out of 546 observations) in the largest of our samples (Table 1). 23 crises took place in developing countries and 8 in developed countries. Of the crises in developing countries, 6 were in Latin America, 7 in Asia, 7 in Africa, and 3 in the Middle East. Thus, our sample includes a relative diverse set of economies.

The explanatory variables

Our choice of explanatory variables reflects both the theory of the determinants of banking crises summarized in Section 2 above and data availability. A list of the variables and their sources is in the data appendix. To capture adverse macroeconomic shocks that hurt banks by increasing the share of non-performing loans, we use as regressors the rate of growth of real GDP, the external terms of trade, and the real short-term interest rate. High short-term real interest rates also affect bank balance sheets adversely if banks cannot increase their lending rates quickly enough, as explained in Section 2. Finally, the real interest rate may also be considered a proxy for financial liberalization, as Galbis (1993) found that the liberalization process tends to lead to high real rates. Financial liberalization, in turn, may increase banking sector fragility because of increased opportunities for

excessive risk-taking and fraud.[15] Pill and Pradhan (1995) find that the variable that best captures the extent to which financial liberalization has progressed is the ratio of credit to the private sector to GDP. Accordingly, we introduce this variable as a regressor in our equations. Another variable that can proxy the progress with financial liberalization is the change in the credit-to-GDP ratio. Since case studies point to a number of episodes in which banking sector problems were preceded by strong credit growth, we experiment with various lags of this variable.

Inflation is introduced as an explanatory variable because it is likely to be associated with high nominal interest rates, and because it may proxy macroeconomic mismanagement which adversely affects the economy and the banking system through various channels. Because stabilization from chronic inflation may lead to a reduction in the size of the banking system which, in turn, may take place through a banking crisis, we also introduce the change in the rate of inflation as a regressor. In addition, the rate of depreciation of the exchange rate is used to test the hypothesis that banking crises may be driven by excessive foreign exchange risk exposure either in the banking system itself or among bank borrowers. To test whether systemic banking sector problems are related to sudden capital outflows in countries with an exchange rate peg we introduce as a regressor the ratio of M2 to foreign exchange reserves. According to Calvo (1996), this ratio is a good predictor of a country's vulnerability to balance-of-payments crises.

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15 We explored the possibility of constructing a financial liberalization dummy using country by country information on the timing of liberalization; however, we abandoned the idea because for most countries in our panel the transition to a more liberalized regime was a very gradual process, sometimes taking a decade or more. Kaminsky and Reinhart (1996) find that a financial liberalization dummy variable tends to predict the occurrence of banking crises in their sample of 20 countries.

The government surplus as a percentage of GDP captures the financing needs of the central government. This variable may matter for two reasons: first, governments strapped for funds often postpone measures to strengthen bank balance sheets, with the result that relatively small problems grow to systemic proportions. According to Lindgren *et al.* (1996):

" *Supervisors often are prevented from intervening in banks because this would bring problems out in the open and `cause' expenditure. Typical justifications for inaction are that `there is no room in the budget' or that the fiscal situation is `too weak' to allow for any consideration of banking problems." (p. 166)*

Even when government officials are prepared to intervene despite budgetary difficulties, the public may believe that they are not, and bank runs may compound the initial problems turning them into a full-fledged crisis. A second reason for including the government fiscal position in the regressions is that failure to control the budget deficit may be a serious obstacle to successful financial liberalization (McKinnon, 1991). Foiled attempts at financial liberalization may, in turn, create problems for the banking system.

Adverse macroeconomic circumstances should be less likely to lead to crises in countries where the banking system is liquid. To capture liquidity we use the ratio of bank cash and reserves to bank assets. We also construct a dummy variable that takes a value of one in countries/years in which an explicit deposit insurance scheme is in place. As discussed in Section 2, the expected sign of this variable is ambiguous, because explicit deposit insurance should reduce the incidence of bank runs but it is likely to increase risk due to moral hazard. Finally, banking sector problems may be due to widespread fraud, or to weak enforcement of loans contracts and/or of prudential regulation in countries where

the legal system is not very efficient; to test this hypothesis, we introduce as regressors indexes of the quality of the legal system, of contract enforcement, and of the bureaucracy, as well as GDP per capita. These proxies may also capture the government's administrative capability which, in turn, is likely to be positively correlated with the effectiveness of prudential supervision of the banking system. Thus, low values of the proxies may mean more opportunities for moral hazard.

IV. THE RESULTS

Tables 2 and 3 contain the main results of our econometric investigation. Table 2 reports four regressions using the panel that excludes observations following the first banking crisis, while Table 3 reports the same regressions for the panel in which observations following the end of a crisis episodes are included. The first specification includes only the macroeconomic variables and GDP per capita, and it encompasses the largest set of countries. In the second specification we add variables capturing some characteristics of the banking sector; in the third regression the deposit insurance dummy variable is included. The fourth regression relies on the smallest sample, and it includes the "law and order" index.

Overall model performance and prediction accuracy

The quality of the model specification is assessed based on three criteria recommended by Amemiya (1981): model chi-square, Akaike's information criterion (AIC),

and in-sample classification accuracy. The model chi-square tests the joint significance of the regressors by comparing the likelihood of the model with that of a model with only the intercept; as shown in Tables 2 and 3, in all the specifications the hypothesis that the coefficients of the independent variables are jointly equal to zero is rejected at the one percent significance level. The AIC criterion is computed as minus the log-likelihood of the model plus the number of parameters being estimated, and it is therefore smaller for better models. This criterion is useful in comparing models with different degrees of freedom. The regressions including only observations before the first crisis seem to perform better, and model four appears to be the best based on AIC.

To assess the prediction accuracy of the various specifications, we report the percentage of crises that are correctly classified, the percentage of non-crises that are correctly classified, and the total percentage of observations that are correctly classified. The model appears to perform fairly well: the overall classification accuracy varies between 67 percent and 84 percent, while up to 70 percent of the banking crises are accurately classified.

It should be pointed out that the percentage of non-crisis observations that are correctly classified tends to downplay the performance of the model, because in a number of episodes the estimated probability of a crisis increases significantly a few years before the episode begins and those observations are considered as incorrectly classified by the accuracy criterion. To illustrate this point, Table 4 reports more details about the classification accuracy of the best of the specifications, namely specification (3) in the second panel. While 26 percent of the crisis episodes were not correctly classified by the model, in 35 percent of the cases the estimated probability jumps up exactly in the year of

the crisis; in 26 percent additional cases the model classifies as a crisis also the year before the crisis began, and, finally, in another 13 percent of the episodes the estimated probability of crisis jumps as early as three years prior to the starting date. These results suggest that the elements that contribute to systemic banking sector fragility may be in place one or more years before problems become manifest.

Significance of the explanatory variables[16]

In both panels, low GDP growth is clearly associated with a higher probability of a banking crisis, confirming that developments in the real side of the economy have been a major source of systemic banking sector problems in the 1980s and 1990s. Also a decline in the terms of trade appears to worsen banking sector unsoundness, but this variable is significant only in two of the specifications and only at the 10 percent confidence level. GDP growth loses significance if it is lagged by one period, indicating that negative shocks work their way to bank balance sheets relatively quickly. Another possible interpretation is that the banking crisis itself causes a decline in the contemporaneous rate of GDP growth as credit to the economy withers. This interpretation would imply that causality runs in the opposite direction than that suggested. However, since credit goes to finance future production and not current production, it seems likely that a decline in credit would affect GDP only with a lag. This interpretation is also supported by the findings of Kaminsky and

[16] The results of regressions using specifications including alternative explanatory variables not reported in Tables 2 and 3 are described in section VI below.

Reinhart (1996), who examine monthly data around the time of a banking crisis and find that the decline in GDP growth tends to precede the onset of the banking crisis by about 8 months.[17]

Both the real interest rate and inflation are highly significant in all the specifications and have the expected sign, confirming the well-known vulnerability of the banking system to nominal and real interest rate shocks; on the other hand, the behavior of the exchange rate does not have an independent effect on the likelihood of a banking sector crisis once inflation and terms of trade changes are controlled for.[18] The fiscal surplus is also not significant. External vulnerability as measured by the ratio of M2 to reserves significantly increases the probability of a crisis in most of the specifications, as predicted by the theory. This variable, however, tends to loose significance when the surplus-to-GDP variable is omitted. [19]

In the previous sections we conjectured that countries where the banking sector has a larger exposure to private sector borrowers should be more vulnerable to banking crises. This conjecture finds some support in our regression results, but the level of significance is low except in one of the specifications. Also the other financial variables (credit growth and the liquidity variable) do not develop a consistently significant coefficient in all of the specifications, although the liquidity variable is significant in the fourth regression using the

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[17] Recall that our panels exclude years in which banking crises are under way, so periods in which growth is likely to be negatively affected by the decline in credit due to the crisis are not in the sample.

[18] When inflation is excluded from the regression, the coefficient of the rate of depreciation becomes significant and negative in most of the specifications.

[19] On other proxies of external vulnerability, see Section VI below.

second panel, and credit growth is significant (and positive) if lagged by two periods in the third specification of the first panel. Thus, there is some evidence that a boom in credit precedes banking crises, but the evidence is not very strong.

As predicted by the theory, low values of the "law and order" index, which should proxy more opportunities to loot and/or a lower ability to carry out effective prudential supervision, are associated with a higher likelihood of a crisis. It should be noted, however, that it is difficult to disentangle the effect of this index from that of GDP per capita, given the high degree of correlation between the two variables in our sample. Finally, the deposit insurance dummy variable has a significant positive sign in both panels. Thus, the presence of an explicit insurance scheme, although it may have reduced the incidence of self-fulfilling bank runs, appears to have worsened banking sector fragility through moral hazard. This result may be taken as evidence that no deposit insurance or perhaps implicit deposit insurance is preferable from the point of view of minimizing banking sector fragility; however, it may more simply reflect weaknesses in the design and implementation of deposit insurance schemes in our sample of countries.[20] Clearly, more work is needed to sort out this issue.

As explained in Section III above, because the empirical model is non-linear the estimated coefficients do not measure the percentage change in the estimated probability of a crisis associated with a given percentage change in the explanatory variable, as in the standard linear regression model. Rather, the impact of a change in each explanatory

[20] On the design and implementation of deposit insurance schemes, see Garcia (1995)

variable depends upon the initial values of all the independent variables and their coefficients. To gain some insight on the relative impact of each explanatory variable, using estimated coefficients from equation (3) in the multicrisis sample we have computed elasticities for a specific and much-studied episode, the Mexican banking crisis of 1994. As shown in Table 5, the largest elasticities are those of the rate of output growth and of the share of private credit to GNP (the latter variable, though, is significant only at the 10 percent confidence level). The real interest rate and lagged credit growth have elasticities of around 0.5, while the external vulnerability variable (the ratio of M2 to reserves) and the rate of inflation have elasticities of 0.27 and 0.22 respectively. A switch from explicit to no deposit insurance would have decreased the probability of a crisis by over 60 percent. This large impact, of course, is due to the fact that a change in the dummy variable from one to zero represents a 100 percent decline. As pointed out in the introduction, these numbers have to be interpreted with caution, since the coefficients come from a reduced form equation and we do not provide a structural model that makes explicit the connections among the various explanatory variables.

V. THE COST OF BANKING CRISES

The approach taken so far treats all banking crises as uniform events. In practice, however, the crises in our panel were of different severity. In this section, we test whether the set of macroeconomic, structural, and institutional variables that are associated with the occurrence of banking crises can also explain observed differences in the severity of the

crisis. We measure the severity of the crises by their cost (as a share of GDP) using the estimates in Caprio and Klingebiel (1996), which are available for 24 of the 31 crisis episodes in our sample. These estimates reflect the fiscal cost of each episode. The explanatory variables are measured in the year in which the crisis begins. In interpreting the results it is important to take into account that the cost of a crisis is an imperfect measure of the severity of the problems because it is influenced also by how well monetary authorities and bank supervisors deal with the crisis. Thus, some of the explanatory variables may be correlated with factors affecting the quality of the policy response rather than with the severity of the crisis.[21]

Table 6 reports the regression results. The coefficients are estimated using OLS, and the standard errors are White's heteroskedasticity-consistent measures. Because the degrees of freedom are few, these results should be taken with caution. Overall, the variables that are significantly correlated with the probability of a crisis are also significantly correlated with the cost of a crisis: among the macro variables, low GDP growth, adverse terms of trade changes, high real interest rates, and high inflation tend to increase the cost of a crisis. Vulnerability to a balance-of-payments crisis, a larger share of credit to the private sector, and lagged credit growth are also significant and of the expected sign (although credit growth is significant only in one of the two specifications in which it is included); the liquidity variable is significant only if the other financial variables are excluded. The deposit

[21] For a review of recent episodes of bank restructuring, see Dziobek and Pazarbaşioğlu (1997).

insurance dummy and the "law and order" index are also significant, indicating that the presence of explicit deposit insurance may not only make banking crises more likely, but it may also make the such crises more expensive to clean up. Conversely, an effective legal system that sanctions fraudulent behavior is likely to reduce both the occurrence of systemic banking problems and their cost.

Finally, a variable capturing the length of the crisis episodes is negatively correlated with the cost. Thus, crises that are cleaned up more quickly appear to be also the most expensive. One possible explanation of this result is that more severe crises force policy makers to take quick and drastic action and, therefore, result in a speedier resolution of the problems. Another interpretation could be that rescue operations that put the banking system back on its feet relatively quickly require more budgetary resources, perhaps because they involve an across-the-board bail out instead of more selective intervention aimed at separating out efficient banks from inefficient institutions.

VI. SENSITIVITY ANALYSIS

In classifying episodes of banking sector fragility as crises or non-crises we have relied on somewhat arbitrary cutoffs; thus, it is important to verify that the main results of the analysis are not sensitive to small changes in the threshold values for the ratio of non-performing loans to bank assets and for the cost of the crisis as a share of GDP. To this end, the regressions in Tables 2 and 3 were replicated using a more restrictive definition of a crisis (ratio of non-performing loans to bank assets above 15 percent and/or cost of crises above 3 percent of GDP) and for a sample with a less restrictive definition (ratio of non-

performing loans to bank assets above 5 percent and/or cost of crises above 1 percent of GDP). In the set of regressions that exclude years after the first crisis, the more restrictive criterion reduces the number of crises to 24 in model 1 and to 14 in model 4, while the less restrictive criterion increases the number to 30 in model 1 and to 20 in model 4. In spite of these changes, all of the results in Tables 2 and 3 remain essentially unaltered. Not surprisingly, the model with the more stringent definition of a banking crisis seems to be the best in terms of goodness of fit, since with the more stringent definition it becomes easier to identify a crisis from a non-crisis.

To scrutinize the robustness of our results further, we have run two more sets of regressions in which we do not exclude from the sample years in which banking crises were ongoing. In the first set of regressions, those years are treated as crisis years, while in the second set they are treated as non-crisis years. The results of these regressions look very much like those of Table 3, in which years after a crisis has ended are included in the panel.

We also estimated the various specifications including the three outlier countries (Argentina, Brazil, and Bolivia). In this case, the rate of inflation and the real interest rate are no longer significant, and some of the other macroeconomic variables become slightly less significant. To gain more insight on the role of inflation and of real interest rates, we estimated a specification in which dummies for the three outlier countries are interacted with inflation and the real interest rate. The dummies are significant and negative in most specifications, suggesting the presence of a "threshold effect", i.e. that after inflation and real interest rates have reached a certain peak further changes no longer affect the probability of a banking crisis.

We have run specifications using the deviation of the GDP growth rate from its country mean instead of the GDP growth rate to test whether a more accurate measure of output shock changed the results; we found that nothing changed. To test whether uncertainty in the macroeconomic environment significantly increases banking sector fragility, we also introduced measures of volatility for GDP growth and inflation measured by the coefficient of variation of each variable by country; neither variable was significant, perhaps because more sophisticated measures of volatility are needed . To test for the possible presence of non-linearities, we ran a specification including the square of the rate of inflation and of the real interest rate, but these terms were not significant. Also, we experimented with different proxies for balance-of-payments vulnerability, such as the ratio of foreign exchange liabilities (gross and net) of the banking sector to reserves, and the capital account surplus; these variables, however, are less significant than the M2-to-reserves ratio.

Indexes of corruption, quality of contract enforcement, quality of the bureaucracy, and delays in the justice system, are less significant than the "law and order" index. A specification including the depth of the banking system as measured by the ratio of bank assets to GDP instead of the liquidity of the banking system does not perform any better than the regressions reported in Tables 2 and 3, and the ratio of M3 to GDP also is not significant in any of the regressions. We have also split the sample between developing and developed countries; interestingly, the deposit insurance dummy and the "law and order" index become more strongly significant in the sample of developing countries.

Finally, as discussed in Section III above we have estimated a version of the model including country fixed effects for a restricted panel including only countries that experienced a banking crisis in the period under consideration. Because of collinearity between the "law and order" index and the country dummies, specifications including this variable did not converge, so the results described below refer to specifications that do not include the index.

The performance of the model as measured by chi-square is as good as in the case without fixed effects, while the AIC criterion suggests a somewhat worse performance; the specification including deposit insurance is still the best based on the AIC. Classification accuracy drops somewhat, but it is still quite good (in the best specification, 89 percent of non-crisis observations and 68 percent of crisis observations are correctly classified). Concerning the significance of individual explanatory variables, the main differences from the results in Tables 2 and 3 are as follows: the change in the terms of trade, which was marginally significant in a few of the specifications without fixed effects, now is no longer significant. The inflation variable, while it is still significant at 5 percent in the first two specifications for the panel excluding all years after a crisis, is no longer significant if the deposit insurance variable is included. Furthermore, in the panel including the years after the crisis has ended significance drops to 15 percent. As in the model without fixed effects, the significance of the financial variables is sensitive to the specification; the variable capturing vulnerability to balance of payments crises, M2-to-reserves, is now significant in only one of the regressions, while the share of credit to the private sector becomes more significant. Of the institutional variables, GDP per capita is significant at the 10 percent level, while the

deposit insurance dummy variable is still significant at the 5 percent level in the first panel, while significance drops to 15 percent in the second panel. The latter result, however, appears to be the effect of dropping non-crisis countries from the panel rather than of the inclusion of country dummies. Furthermore, the inclusion of deposit insurance still considerably improves the performance of the regression. Thus, estimation of the smaller panel with fixed effects does not yield a substantially different picture of the factors associated with systemic banking crises than that reported in Tables 2 and 3.

VII. CONCLUSIONS

Since the early 1980s systemic banking sector problems have emerged repeatedly all over the world, and the need to understand the connections between banking sector fragility and the economy is all the more urgent. The now numerous case studies indicate that, while experiences vary quite substantially across countries and over time, there may be factors common to all banking crises. This paper attempts to identify some of these common threads by estimating a multivariate logit model for a large panel of countries.

We find that banking crises tend to emerge when the macroeconomic environment is weak; in particular, low GDP growth is significantly and robustly correlated with increased risk to the banking sector. Vulnerability to aggregate output shocks is not necessarily a sign of an inefficient banking system, as the role of banks as financial intermediaries by its very nature involves some risk-taking. However, banks could hedge some of the credit risk due to fluctuations of the domestic economy by lending abroad. From this perspective, the

expansion of cross-border banking activities should improve the strength of banks all over the world. Small developing countries, whose output is typically more volatile, should especially benefit from increased internationalization. Entry by foreign banks could also be beneficial by increasing competition and putting pressure on local authorities to upgrade the institutional framework for banking activities, although lack of knowledge of local firms and of domestic market conditions may constitute a significant barrier. In future work, we plan to explore in more depth the connection between volatility, country size, and banking sector fragility.

Our results also indicate that an increased risk of banking sector problems may be one of the consequences of a high rate of inflation, possibly because the high and volatile nominal interest rates associated with high inflation make it difficult for banks to perform maturity transformation. Thus, restrictive monetary policies that keep inflation in check are desirable from the point of view of banking sector stability. However, when such policies are implemented in the context of an inflation stabilization program they may lead to a sharp increase in real interest rates; as our empirical evidence shows, high real rates tend to increase the likelihood of a banking crisis. Thus, the design and implementation of effective inflation stabilization programs should be accompanied by a careful evaluation of the impact on the domestic banking system, and, in countries where the banking system appears weak, the benefits of inflation stabilization should be carefully weighted against the costs of a possible banking crisis.

High real interest rates may be the consequence of a host of factors other than inflation stabilization policies (Brock, 1995). Among these factors is financial liberalization

which, in turn, is often named as one of the culprits for banking sector fragility in the policy debate. We have found some (not very strong) evidence that a proxy for the degree of financial liberalization significantly increases the likelihood of banking crises even when real interest rates are controlled for; we plan to explore this issue further in future extensions by developing more accurate indicators of financial liberalization.

Our regressions indicate rather unambiguously that the presence of an explicit deposit insurance scheme tends to increase the probability of systemic banking problems. This suggests that, while deposit insurance may reduce the incidence of self-fulfilling banking panics, it introduces a significant degree of moral hazard which often has not been successfully curbed through appropriate design of the insurance scheme or through effective prudential supervision and regulation. Thus, reducing the moral hazard induced by deposit insurance should be a priority for policy-makers interested in strengthening the banking system; also, opting for an implicit rather than explicit deposit insurance scheme may be preferable while the administrative capability needed to enforce a system of prudential regulation is being created. To explore this issue further, we plan to test whether banking sector fragility is affected by specific features of the deposit insurance system such as the extent of the coverage, the type of premia charged to banks, the public or private nature of the scheme, the presence of coinsurance and deductibles, and others.

Our study has several limitations, some of which we hope to address in future work. One is that we have focused on macroeconomic variables at the expense of variables that capture the structure of the banking system and, more generally, of financial markets that are likely to play an important role. Aspects such as the degree of capitalization of banks, the

degree of concentration and the structure of competition of the market for credit, the liquidity of the interbank market and of the bond market, the ownership structure of the banks (public versus private), the quality of regulatory supervision, and so on ought to be controlled for but are neglected here because of lack of data. Perhaps a study limited to a smaller set of countries that includes more structural variables could yield interesting results, and allow us to control for the quality of impact of the regulatory response to the crisis. Another direction for future work is to develop a structural macro-model of the economy in which the banking sector plays an explicit role; with the help of such a model, it should be possible to obtain a more precise interpretation for the reduced form coefficients estimated here.

Table 1. Banking Crises by Country

Country	Banking Crisis Date
Colombia	1982-85
Finland	1991-94
Guyana	1993-95
Indonesia	1992-94
India	1991-94
Israel	1983-84
Italy	1990-94
Jordan	1989-90
Japan	1992-94
Kenya	1993
Sri Lanka	1989-93
Mexico	1982, 1994
Mali	1987-89
Malaysia	1985-88
Nigeria	1991-94
Norway	1987-93
Nepal	1988-94
Philippines	1981-87
Papua New Guinea	1989-94
Portugal	1986-89
Senegal	1983-88
Sweden	1990-93
Turkey	1991, 1994
Tanzania	1988-94
US	1981-92
Uganda	1990-94
Uruguay	1981-85
Venezuela	1993-94
South Africa	1985

Table 2. Banking Crisis Determinants - Single Crisis

Dependent variable takes the value 1 if there is a crisis and 0 if there is no crisis. Time-series cross-country data are pooled over the 1980-1994 time period. Observations after the the first crisis are omitted. We estimate the probability P(t) of a financial crisis after taking the logit transformation of P(t). Standard errors are given in paranthesis.

	(1)	(2)	(3)	(4)
Macro Variables:				
GROWTH	-.067***	-.136***	-.252***	-.228***
	(.025)	(.039)	(.063)	(.059)
TOT CHANGE	-.030*	-.025	-.043*	-.045
	(.019)	(.020)	(.027)	(.032)
DEPRECIATION	.002	-.001	-.002	-.012
	(.006)	(.007)	(.008)	(.012)
RL. INTEREST	.088***	.086***	.131***	.113***
	(.024)	(.025)	(.039)	(.035)
INFLATION	.040***	.044***	.053**	.079**
	(.016)	(.018)	(.023)	(.035)
SURPLUS/GDP	.012	.024	.016	.013
	(.034)	(.036)	(.053)	(.048)
Financial Variables:				
M2/RESERVES		.012**	.014**	.018**
		(.005)	(.007)	(.009)
PRIVATE/GDP		.019*	.033**	.009
		(.012)	(.015)	(.010)
CASH/BANK		.009	.018	-.049
		(.016)	(.023)	(.039)
CREDIT GROt-2		.007	.022**	-.003
		(.012)	(.010)	(.020)
Institutional Variables:				
GDP/CAP	-.034	-.090*	-.158**	
	(.033)	(.055)	(.079)	
DEPOSIT INS.			1.415**	
			(.738)	
LAW & ORDER				-.516**
				(.238)
No. of Crisis	28	26	20	18
No. of Obs.	546	493	395	268
% total correct	74	77	79	67
% crisis correct	61	58	55	61
% no-crisis correct	75	78	81	67
model 2	31.88***	40.86***	53.79***	30.37***
AIC	204	187	131	126

*, **and *** indicate significance levels of 10, 5 and 1 percent respectively.

Table 3. Banking Crisis Determinants : Multiple Crises

Dependent variable takes the value 1 if there is a crisis and the value 0 if there is no crisis. Observations for the duration of the crises are omitted. Multiple crises are included. Time-series cross-country data are pooled over the 1980-1994 time period. We estimate the probability P(t) of a financial crisis after taking the logit transformation of P(t). Standard errors are given in paranthesis.

	(1)	(2)	(3)	(4)
Macro Variables:				
GROWTH	-.076***	-.149***	-.254***	-.226***
	(.024)	(.040)	(.059)	(.056)
TOT CHANGE	-.027	-.025	-.034	-.035
	(.019)	(.020)	(.027)	(.028)
DEPRECIATION	.008	.006	.006	.001
	(.006)	(.006)	(.007)	(.007)
RL. INTEREST	.067***	.072***	.106***	.083***
	(.020)	(.022)	(.034)	(.028)
INFLATION	.023**	.035***	.037**	.043**
	(.012)	(.013)	(.018)	(.020)
SURPLUS/GDP	-.016	-.009	-.032	-.008
	(.030)	(.032)	(.049)	(.043)
Financial Variables:				
M2/RESERVES		.016***	.016***	.021***
		(.006)	(.007)	(.009)
PRIVATE/GDP		.013	.024*	-.001
		(.013)	(.015)	(.011)
CASH/BANK		-.013	-.004	-.046*
		(.019)	(.025)	(.031)
CREDIT GRO t-2		.011	.024***	.007
		(.010)	(.009)	(.014)
Institutional Variables:				
GDP/CAP	-.032	-.089*	-.126*	
	(.033)	(.056)	(.071)	
DEPOSIT INS.			1.130**	
			(.630)	
LAW & ORDER				-.389*
				(.218)
Past Crisis:				
DURATION of last period	.157***	.180***	.119*	.219**
	(.053)	(.059)	(.075)	(.089)
No. of Crisis	31	29	23	20
No. of Obs.	645	581	483	350
% correct	75	77	84	74
% crisis correct	55	66	70	65
% no-crisis correct	76	77	84	75
model 2	42.63***	55.54***	64.15***	37.86***
AIC	224	201	149	141

*, **and *** indicate significance levels of 10, 5 and 1 percent respectively.

Table 4. The Model As An Early Warning System

The model used is specification (3) from Table 3. The cut-off probability is equal to the in sample crisis frequency, which is .05.

Country	Crisis Date	Not predicted as a crisis	Predicted as a crisis in the year of the crisis	Predicted as a crisis starting 1 year prior	Predicted as a crisis starting 3 or more years prior
Colombia	1982	X			
Finland	1991			X	
Indonesia	1992			X	
India	1991			X	
Israel	1983			X	
Italy	1990	X			
Jordan	1989			X	
Japan	1992		X		
Kenya	1993				X
Sri Lanka	1989	X			
Mexico	1982		X		
	1994				X
Malaysia	1985		X		
Nigeria	1991	X			
Norway	1987	X			
Philippines	1981	X			
Portugal	1986		X		
Turkey	1991		X		
	1994		X		
US	1981		X		
Uruguay	1981		X		
Venezuela	1993			X	
S. Africa	1985				X
Percent in each category	23 crisis episodes	26	35	26	13

Table 5. Interpreting Regression Coefficients - 1994 Mexican Crisis

The model used is specification (3) from Table 3. Given a change in an explanatory variable the change in the probability of a crisis depends on the country's initial crisis probability, thus on the initial values of all the independent variables and their estimated coefficients. Below, we calculate the impact of a given change in the variables with significant coefficients on the predicted probability of the 1994 Mexican crisis.

	Initial Value	Percent Change in Initial Value	Percent Change in the Probability of Crisis
GROWTH	3.7	+10	-7.0***
RL. INTEREST	6.7	+10	+5.6***
INFLATION	7.3	+10	+2.2**
M2/RESERVES	20.5	+10	+2.7***
PRIVATE/GDP	39.7	+10	+7.8*
CREDIT GROt-2	28.9	+10	+5.4***
GDP/CAP	1830	+10	-1.7*
DEPOSIT INS.	1 (=explicit)	-100 (0=implicit)	-61.6**

*, **and *** indicate significance levels of 10, 5 and 1 percent respectively.

Table 6. Determinants of Cost of Crisis

Dependent variable is the cost of the crisis as a percentage of GDP. The regression is estimated using Ordinary Least Squares. Independent variables correspond to the year of the crisis unless otherwise noted. White's heteroskedasticity-consistent standard errors are given in paranthesis.

	(1)	(2)	(3)	(4)
GROWTH	.580	.313	-1.119***	-1.233***
	(.407)	(.279)	(.393)	(.389)
TOT CHANGE	-.215	-.025	-1.226***	-1.470***
	(.223)	(.200)	(.285)	(.347)
DEPRECIATION	.016	.083*	.157***	.037
	(.077)	(.049)	(.054)	(.069)
RL. INTEREST	.466***	.564***	.456***	.281*
	(.143)	(.131)	(.093)	(.150)
INFLATION	.454***	.533***	.417***	.273**
	(.142)	(.129)	(.087)	(.138)
CASH/BANK		-.338***	.197	.266
		(.112)	(.151)	(.170)
M2/RESERVES			.151***	.232***
			(.057)	(.050)
PRIVATE/GDP			.362***	.215**
			(.127)	(.122)
CREDIT GROt-2			.174	.289***
			(.112)	(.095)
GDP/CAP	.531	.281		
	(.311)	(.337)		
DEPOSIT INS			8.242**	11.699***
			(3.460)	(3.340)
LAW & ORDER			-5.796**	-5.026***
			(2.207)	(1.690)
DURATION				-2.252**
				(.795)
Adj. R2	.32	.40	.43	.54
No. of Obs.	24	24	19	19

*, **and *** indicate significance levels of 10, 5 and 1 percent respectively.

APPENDIX I

SAMPLE COMPOSITION AND DATA SOURCES

The countries included in the largest sample (regression no. 1 in Table 3) are the following: Austria, Australia, Burundi, Belgium, Bahrain, Canada, Switzerland, Chile, Congo, Colombia, Cyprus, Denmark, Ecuador, Egypt, Finland, France, United Kingdom, Germany, Greece, Guatemala, Guyana, Honduras, Indonesia, India, Ireland, Israel, Italy, Jamaica, Jordan, Japan, Kenya, Korea, Sri Lanka, Mexico, Mali, Malaysia, Niger, Nigeria, Netherlands, Norway, Nepal, New Zealand, Peru, Philippines, Papua New Guinea, Portugal, Paraguay, Senegal, Singapore, El Salvador, Sweden, Swaziland, Seychelles, Syria, Togo, Thailand, Turkey, Tanzania, Uganda, Uruguay, USA, Venezuela, South Africa, Zaire, Zambia.

For most countries the years included are 1981-94; for some countries, however, a shorter subperiod was included because of lack of data. Thus, some countries in the sample had a banking crisis during 1981-94, but because of missing data in the years of the crisis that crisis does not appear in Table 1 (Chile, Thailand, and Peru are such examples). The following table provides details on the composition of each of the samples used.

Table A.1: Composition of the Samples

Regression 2, multiple crises	United Kingdom, Sweden, Zaire
Regression 3, multiple crises	Burundi, Bahrain, Congo, Cyprus, Gabon, United Kingdom, Guyana, Mali, Niger, Nepal, Papua New Guinea, Senegal, Singapore, Sweden, Swaziland, Seychelles, Tanzania, Zaire
Regression 4, multiple crises	Burundi, Congo, United Kingdom, Niger, Nepal, Senegal, Singapore, Swaziland, Seychelles, Zaire
Regression 1, single crisis	Chile, Peru, Turkey
Regression 2, single crisis	Chile, United Kingdom, Peru, Singapore, Sweden, Turkey, Zaire
Regression 3, single crisis	Burundi, Bahrain, Chile, Congo, Cyprus, Gabon, United Kingdom, Guyana, Mali, Niger, Nepal, Peru, Papua New Guinea, Senegal, Singapore, Sweden, Swaziland, Seychelles, Turkey, Tanzania, Zaire
Regression 4, single crisis	Burundi, Bahrain, Chile, Congo, Cyprus, Gabon, United Kingdom, Guyana, Israel, Mali, Niger, Nepal, Peru, Papua New Guinea, Senegal, Singapore, Sweden, Swaziland, Seychelles, Turkey, Tanzania, Zaire

Table A.2: Description of the Explanatory Variables and Sources

Variable Name	Definition	Source
Growth	Rate of growth of real GDP per capita	IFS data base where available. Otherwise, WEO data base.
Tot change	Change in the terms of trade	IFS
Depreciation	Rate of change of the exchange rate	IFS
Real interest rate	Nominal interest rate minus rate of inflation	IFS. Where available, nominal rate on short-term government securities. Otherwise, a rate charged by the Central Bank to domestic banks such as the discount rate; otherwise, the commercial bank deposit interest rate
Inflation	Rate of change of the GDP deflator	IFS
Surplus/GDP	Ratio of Central Government budget surplus to GDP	IFS
M2/reserves	Ratio of M2 to foreign exchange reserves of the Central Bank	M2 is money plus quasi-money (lines 34 + 35 from the IFS). Reserves are from the IFS.
Private/GDP	Ratio of domestic credit to the private sector to GDP	Domestic credit to the private sector is line 32d from the IFS.
Cash/bank	Ratio of bank liquid reserves to bank assets	Bank reserves are line 20 of the IFS. Bank assets are lines 21 + lines 22a to 22f of the IFS.
Credit growth	Growth rate of real domestic credit	see above
Deposit insurance	Dummy variable for the presence of an explicit deposit insurance scheme	Data from Kyei (1995) and Talley and Mas (1990)
Law and order	An index of the quality of law enforcement	International Country Risk Guide

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